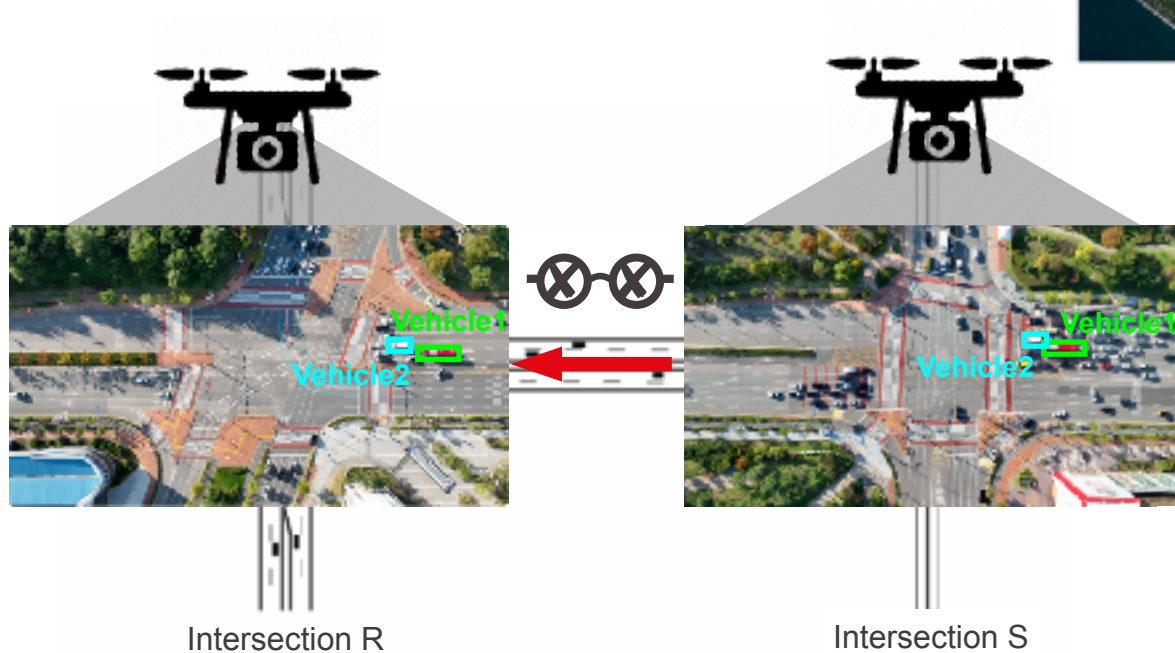


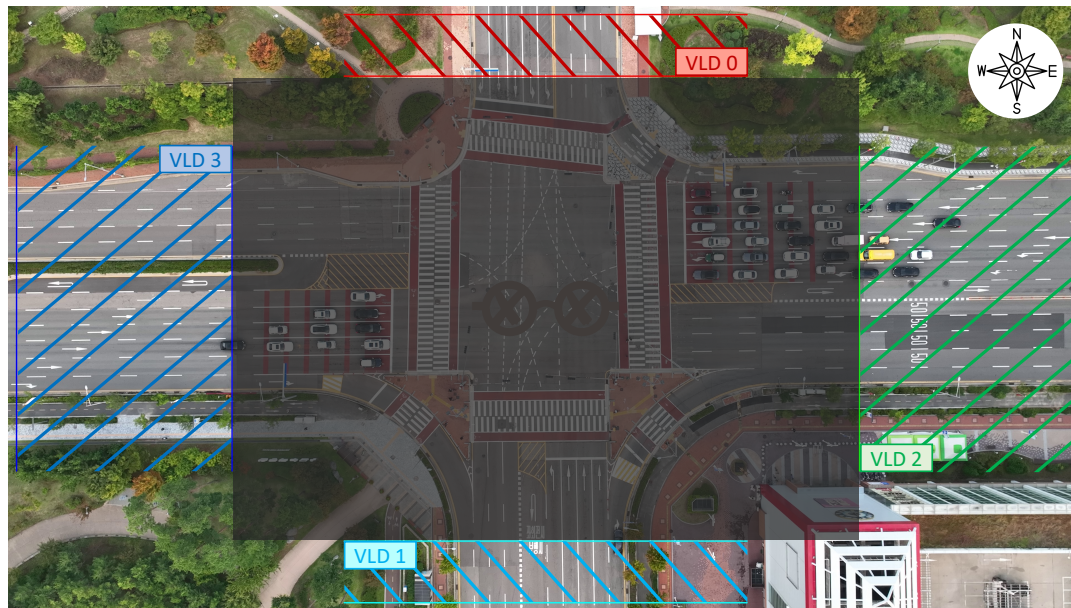
# Motivation

## Multiple UAV Re-ID



# Experimental Environment

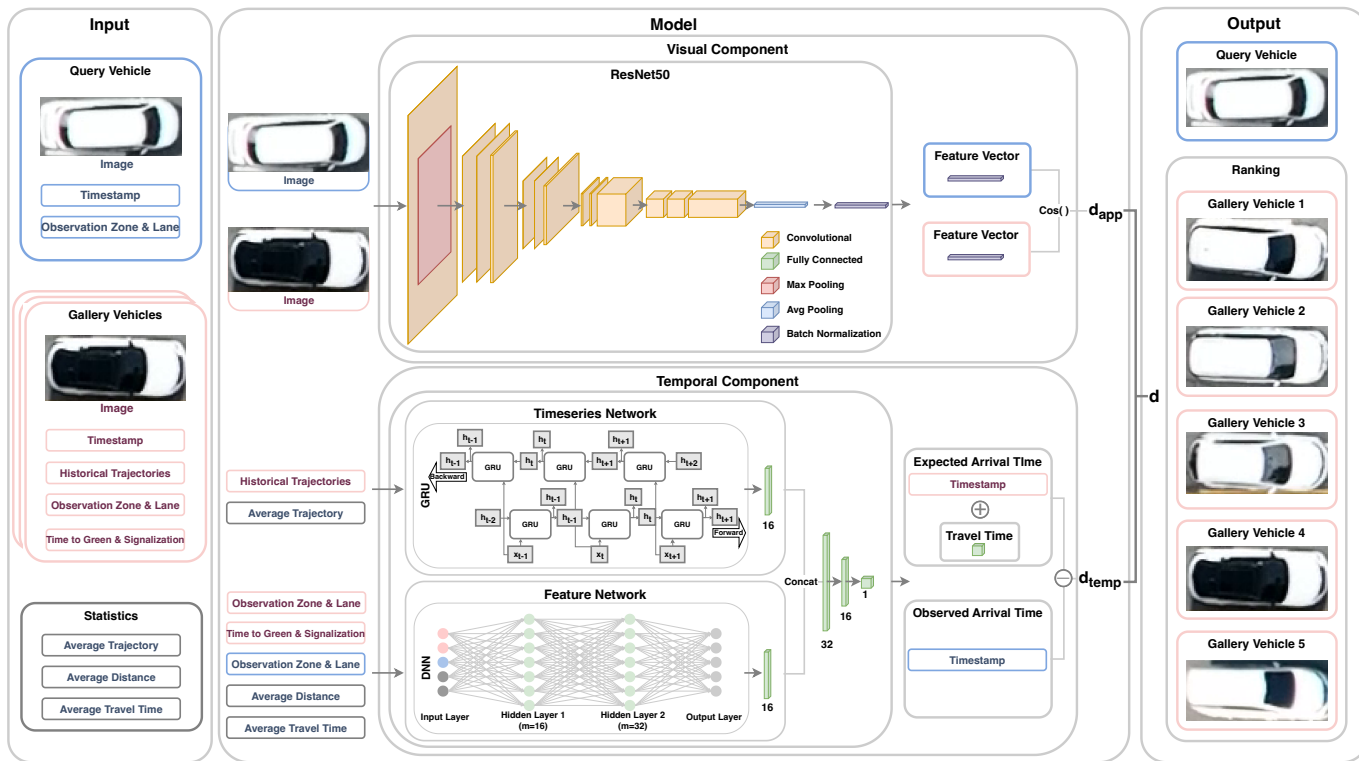
## Virtual Loop Detector (VLD)



# Framework Overview

Post-processing using Spatio-temporal Information

$$d(q_i, q_j) = \begin{cases} 1, & \text{if } t_{q_i} < t_{q_j} \\ d(q_i, g_j), & \text{otherwise} \end{cases}$$



$$d_{app}(q_i, g_j) = \frac{emb_{q_i} \cdot emb_{g_j}}{\|emb_{q_i}\| \|emb_{g_j}\|}$$

$$d_{temp}(q_i, g_j) = \begin{cases} \frac{\max(0, t_{q_i} - t_{g_j})}{\max(1, 2)} & \text{if } t_{q_i} < t_{g_j} \\ 1 & \text{otherwise} \end{cases}$$

$$t = [t_{q_i} - [t_{q_i} - t_{g_j}]]$$

# Result

## Proposed Framework

TABLE III: Framework Performance

|                                        | $\alpha_{opt}$ | Metrics |       |       |
|----------------------------------------|----------------|---------|-------|-------|
|                                        |                | mAP     | CMC-1 | CMC-5 |
| Baseline (visual)                      | 0.00           | 0.778   | 0.686 | 0.908 |
| Proposed Framework (visual + temporal) | 0.22           | 0.949   | 0.915 | 0.984 |
| Proposed Framework                     |                |         |       |       |

mAP (mean Average Precision)

$$mAP = \frac{\sum_{q=1}^Q AP(q)}{Q}$$

$n$  = number of test tracks

$N_g$  = number of ground truths

$P(k)$  = precision at cut-off  $k$  in the result lists

$gt(k) = 1$  if  $k$ -th result is correct

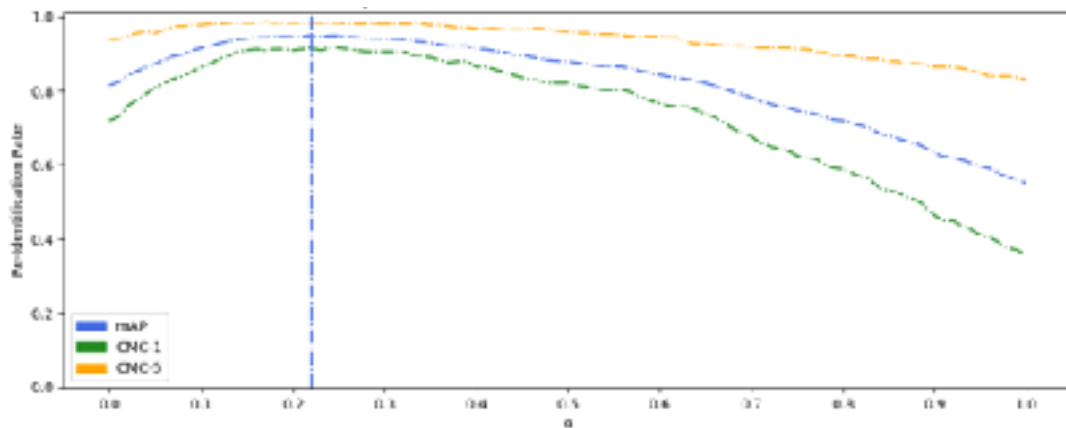
$Q$  = number of queries

$$AP = \frac{\sum_{k=1}^n P(k) \times gt(k)}{N_{gt}}$$

CMC (Cumulative Matching Curve)

$$CMC = \frac{\sum_{u=1}^V c(u, l)}{V}$$

$c(u, l) = 1$  when the ground truth of  $u$  image occurs before rank  $k$

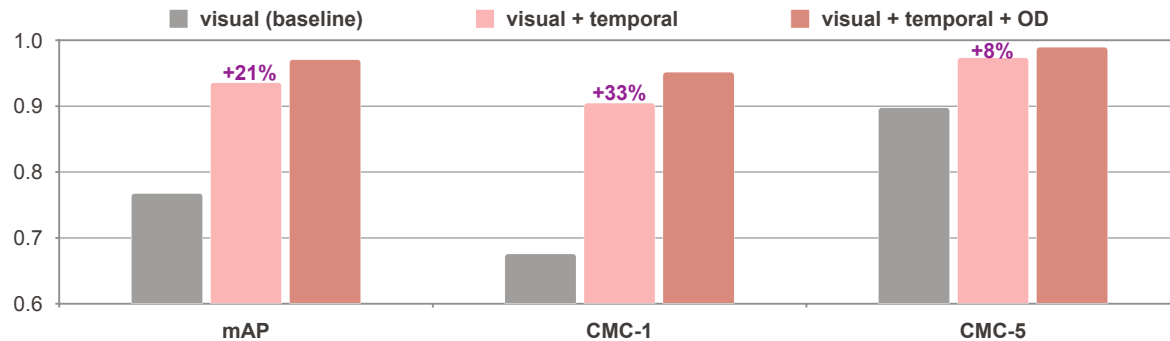


# Result

## Proposed Framework

TABLE III: Framework Performance

|                                                            | $\alpha_{opt}$ | Metrics |       |       |
|------------------------------------------------------------|----------------|---------|-------|-------|
|                                                            |                | mAP     | CMC-1 | CMC-5 |
| Baseline (visual)                                          | 0.00           | 0.775   | 0.586 | 0.908 |
| Proposed Framework (visual + temporal)                     | 0.22           | 0.949   | 0.915 | 0.984 |
| Proposed Framework (visual + temporal) with OD information | 0.22           | 0.981   | 0.962 | 1.000 |



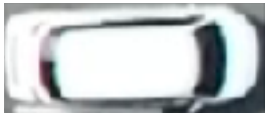
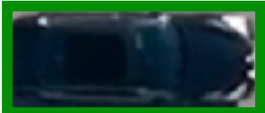
# Result

## Top-5 Ranking - Baseline

| Query Vehicle                                                                     | Top-5 Gallery Vehicles                                                            |                                                                                    |                                                                                     |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                                                                                   | Rank 1                                                                            | Rank 2                                                                             | Rank 3                                                                              | Rank 4                                                                              | Rank 5                                                                              |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

# Result

## Top-5 Ranking - Proposed Framework

| Query Vehicle                                                                     | Top-5 Gallery Vehicles                                                            |                                                                                    |                                                                                     |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                                                                                   | Rank 1                                                                            | Rank 2                                                                             | Rank 3                                                                              | Rank 4                                                                              | Rank 5                                                                              |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |